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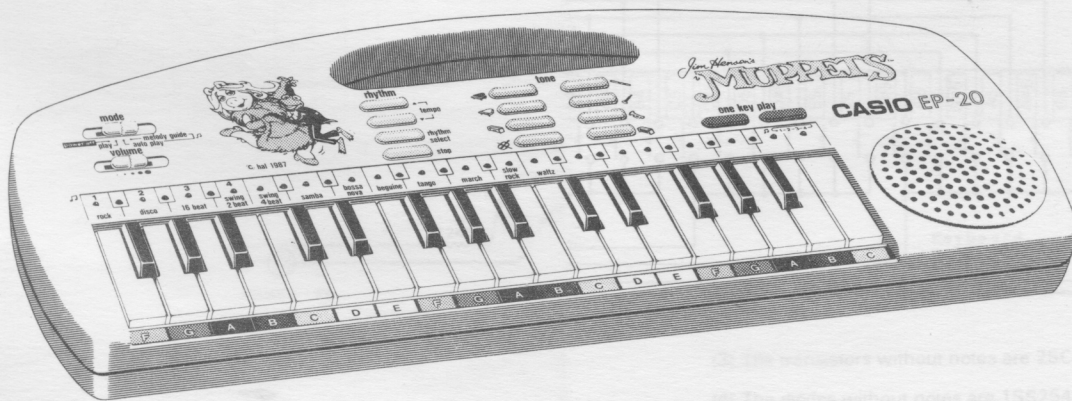
SERVICE MANUAL & PARTS LIST

(without price)

ELECTRONIC KEYBOARD

EP-20

MAY 1987



CASIO®

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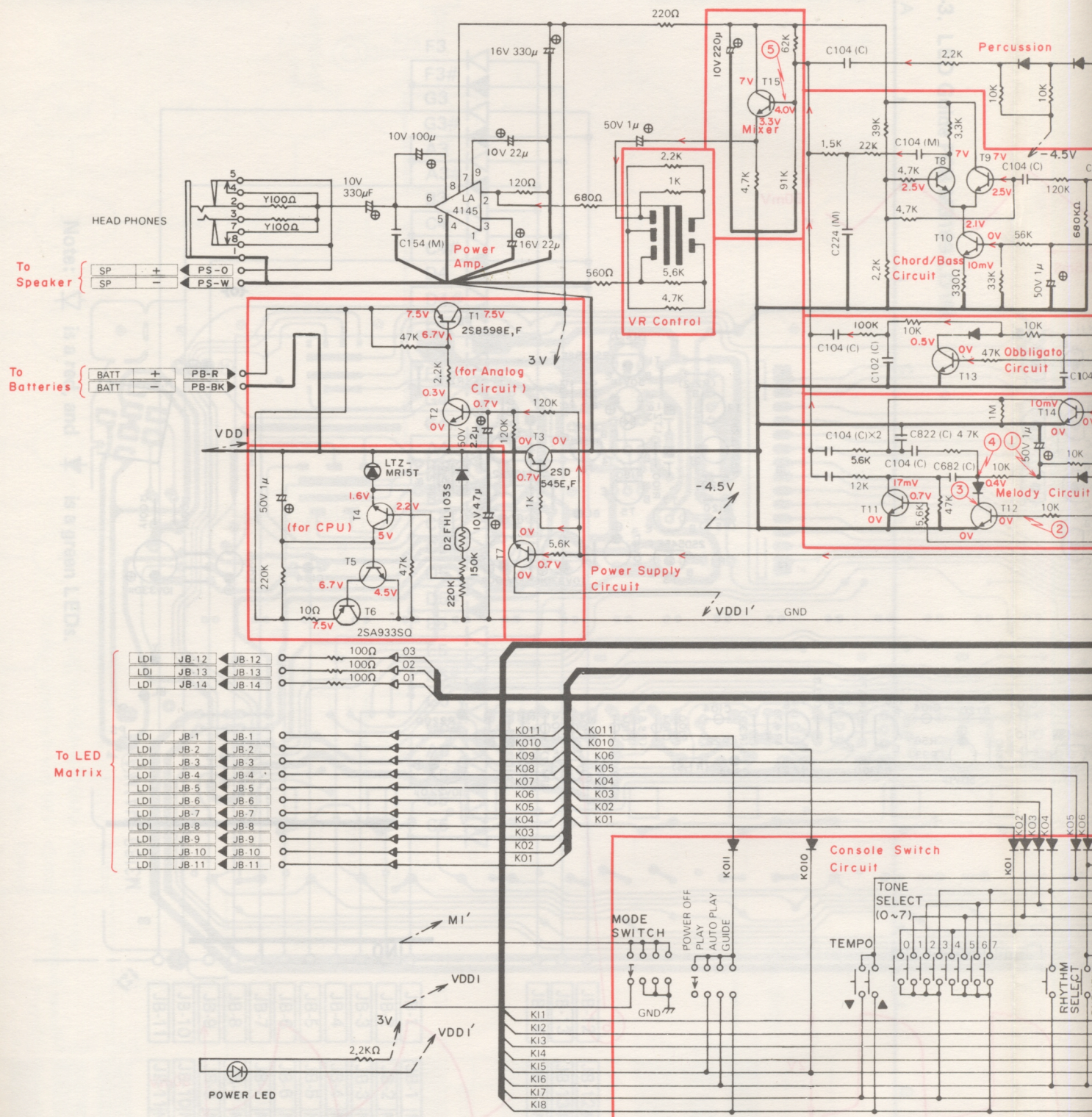
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CASIO

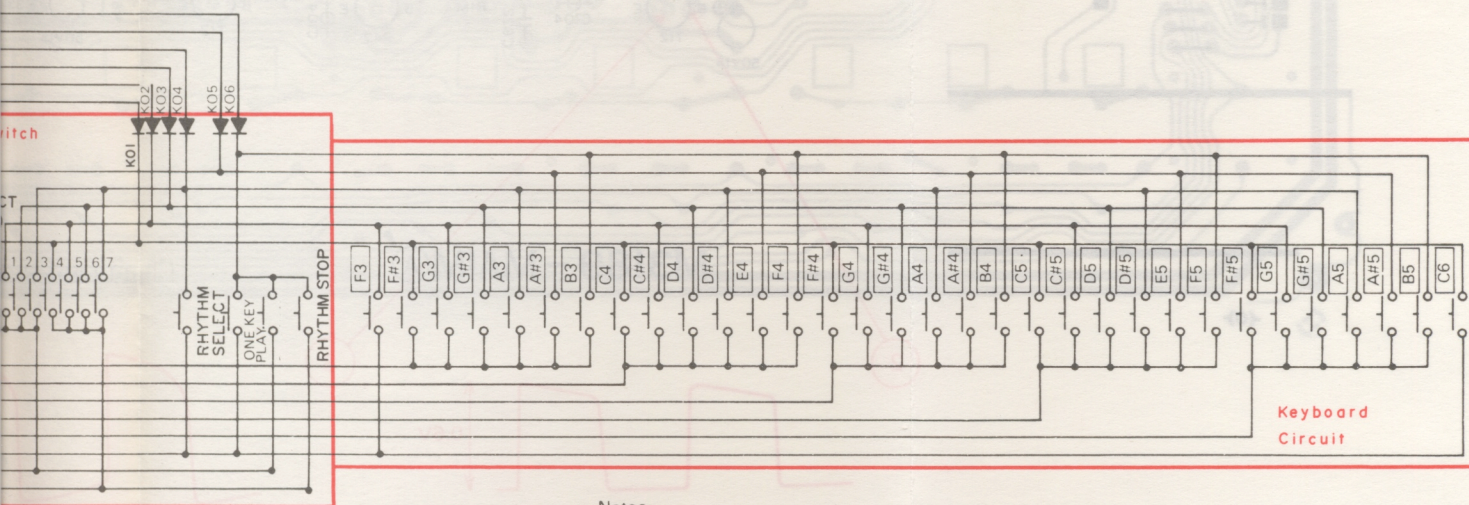
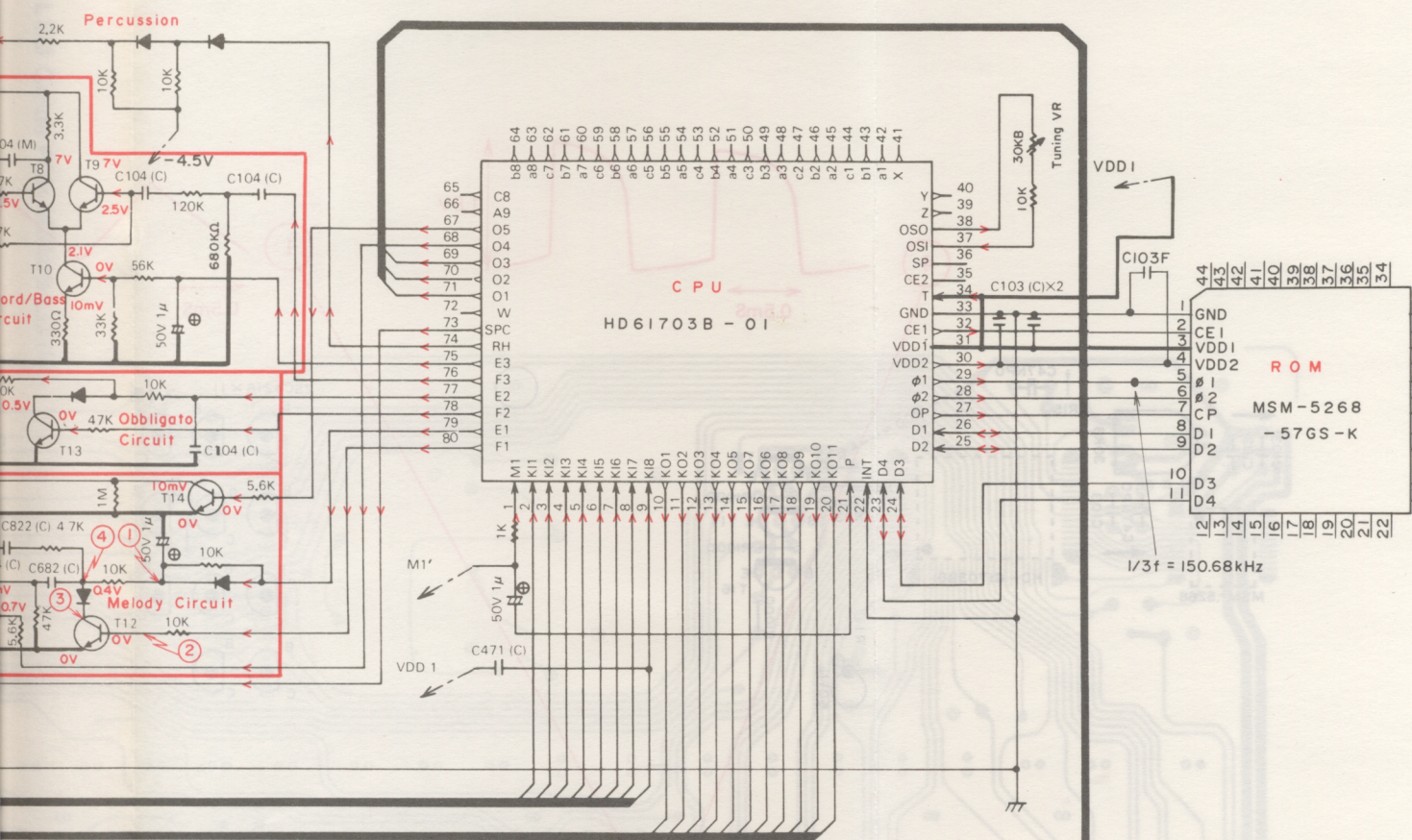
1. SCHEMATIC DIAGRAM

1-1. Main PCB M3189-MA1M



- Tones:
- 0 Piano
 - 1 Harps
 - 2 Organ
 - 3 Violin
 - 4 Flute
 - 5 Clarin
 - 6 Trump
 - 7 Celos

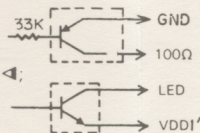
Note: When the tone is "FLUTE" at Key A4.



Tones:
0 Piano
1 Harpsichord
2 Organ
3 Violine
4 Flute
5 Clarinet
6 Trumpet
7 Celesta

Notes
(1) Actual circuit of Δ ;

(2) Actual circuit of Δ ;

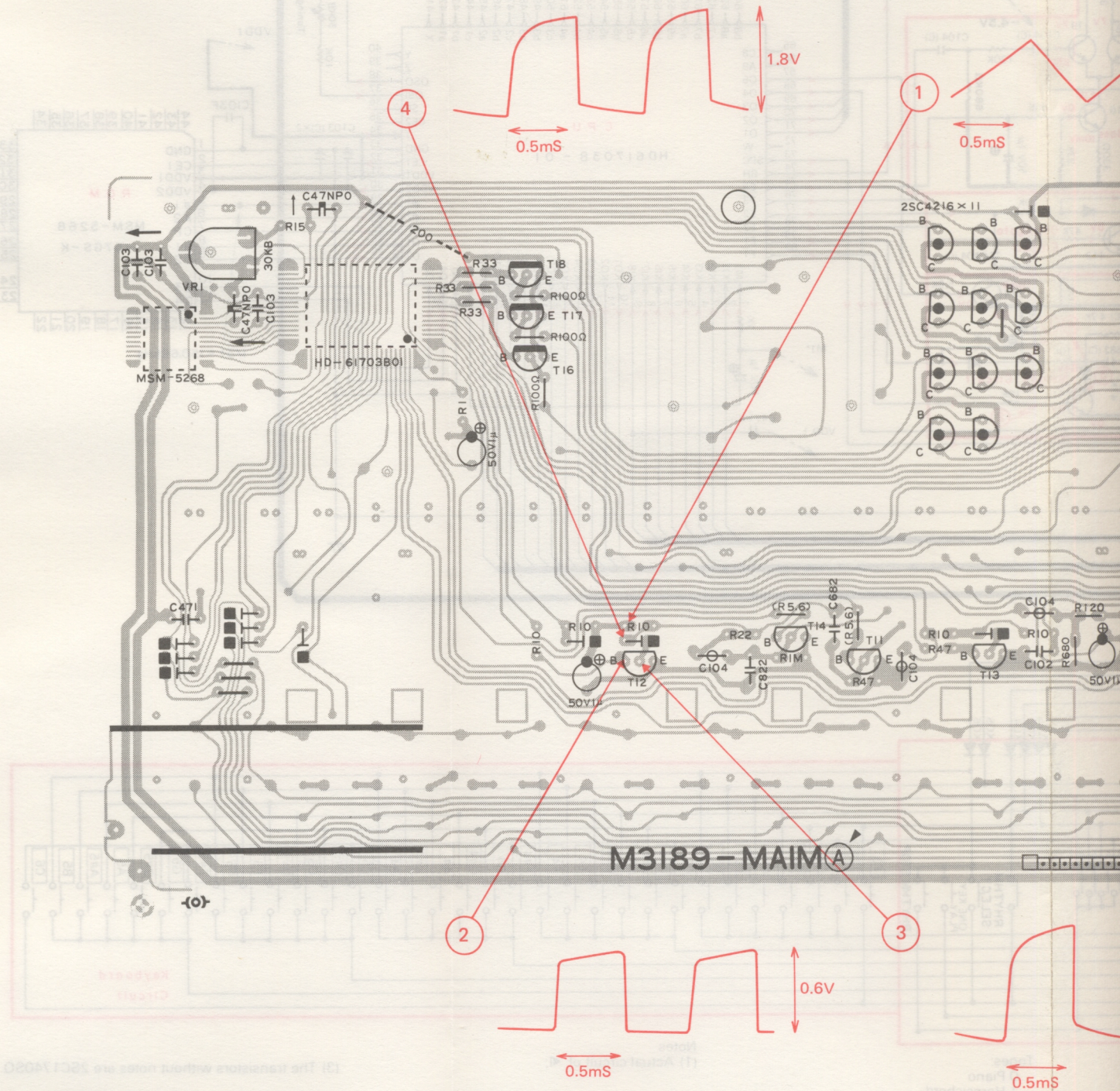


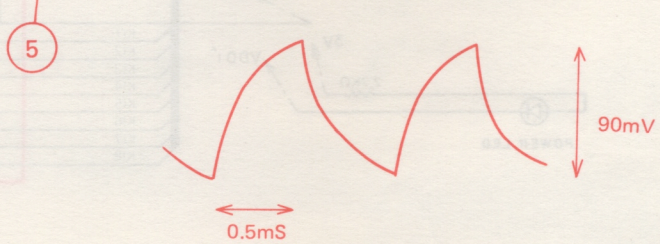
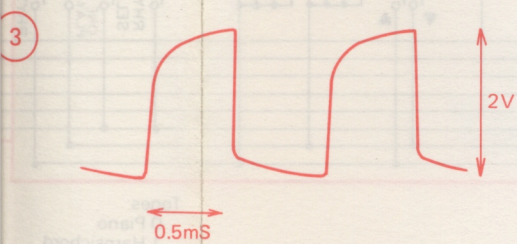
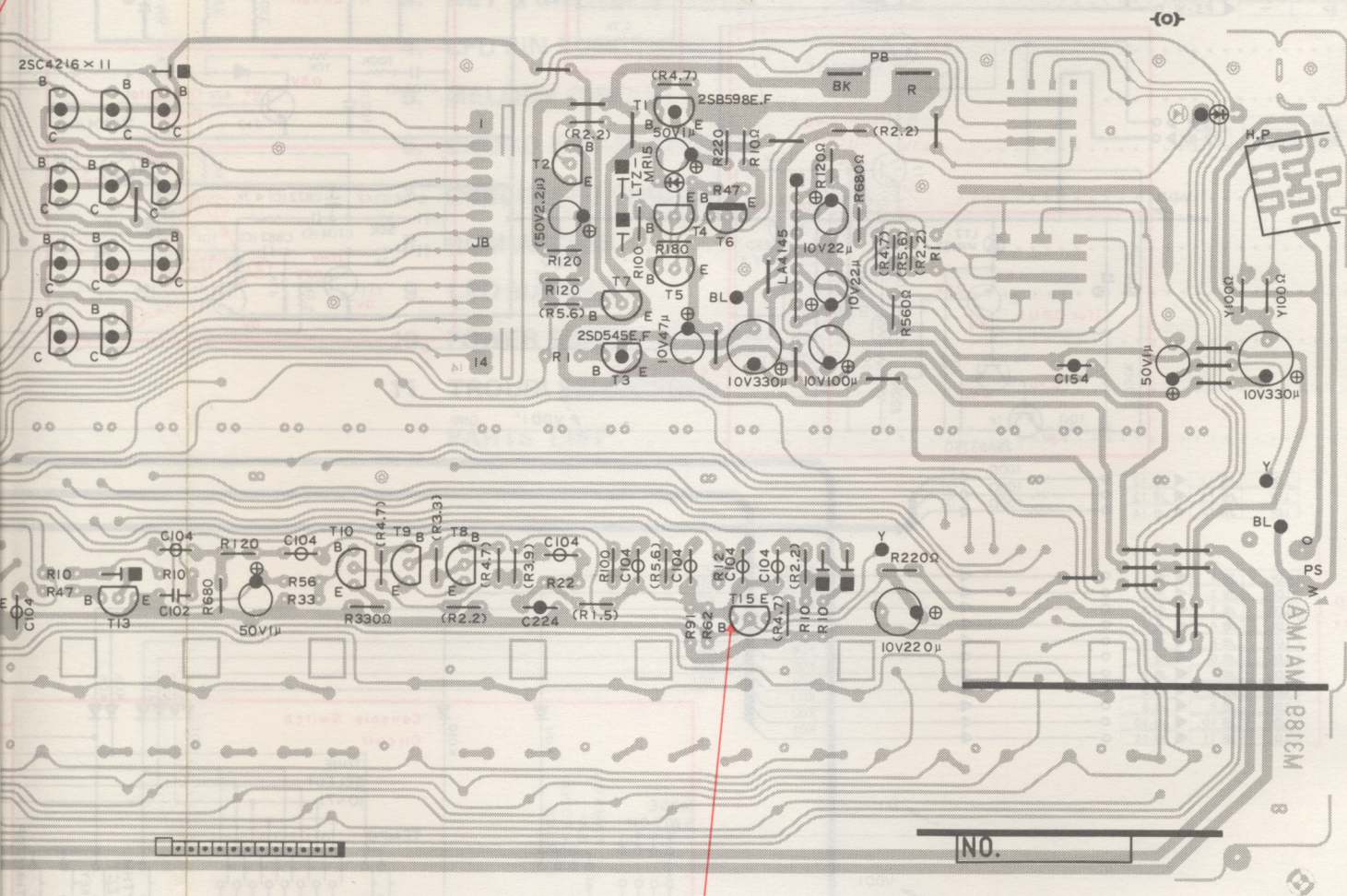
(3) The transistors without notes are 2SC1740SQ.

(4) The diodes without notes are 1SS254.

(5) C104(C)s are semi-conductive capacitor.

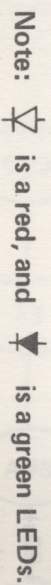
1-2. PCB Layout and Major Waveforms



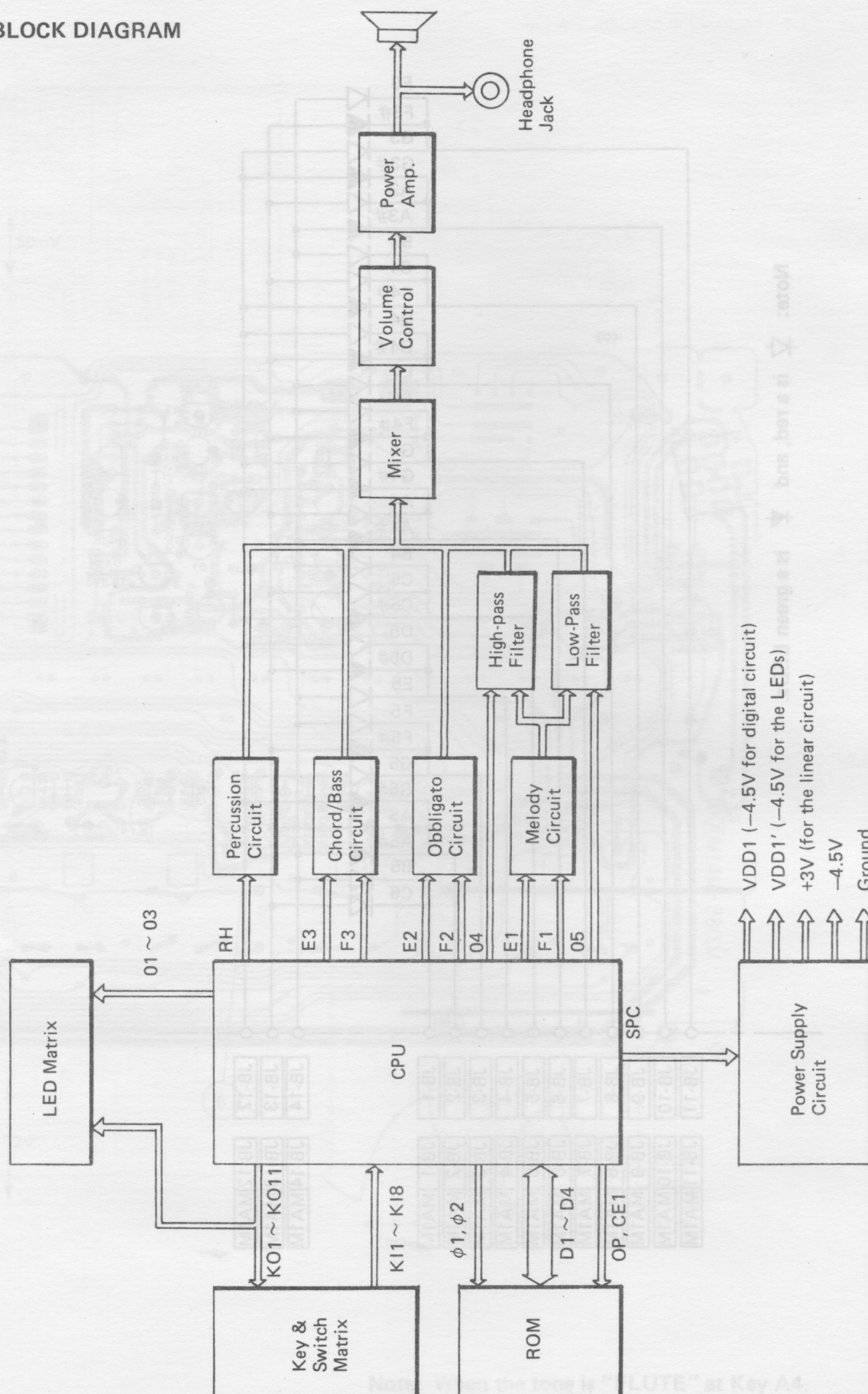


Note: When the tone is "FLUTE" at Key A4.

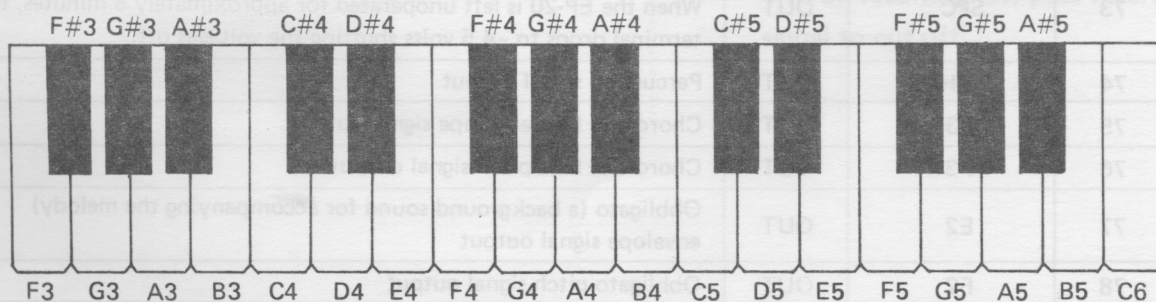
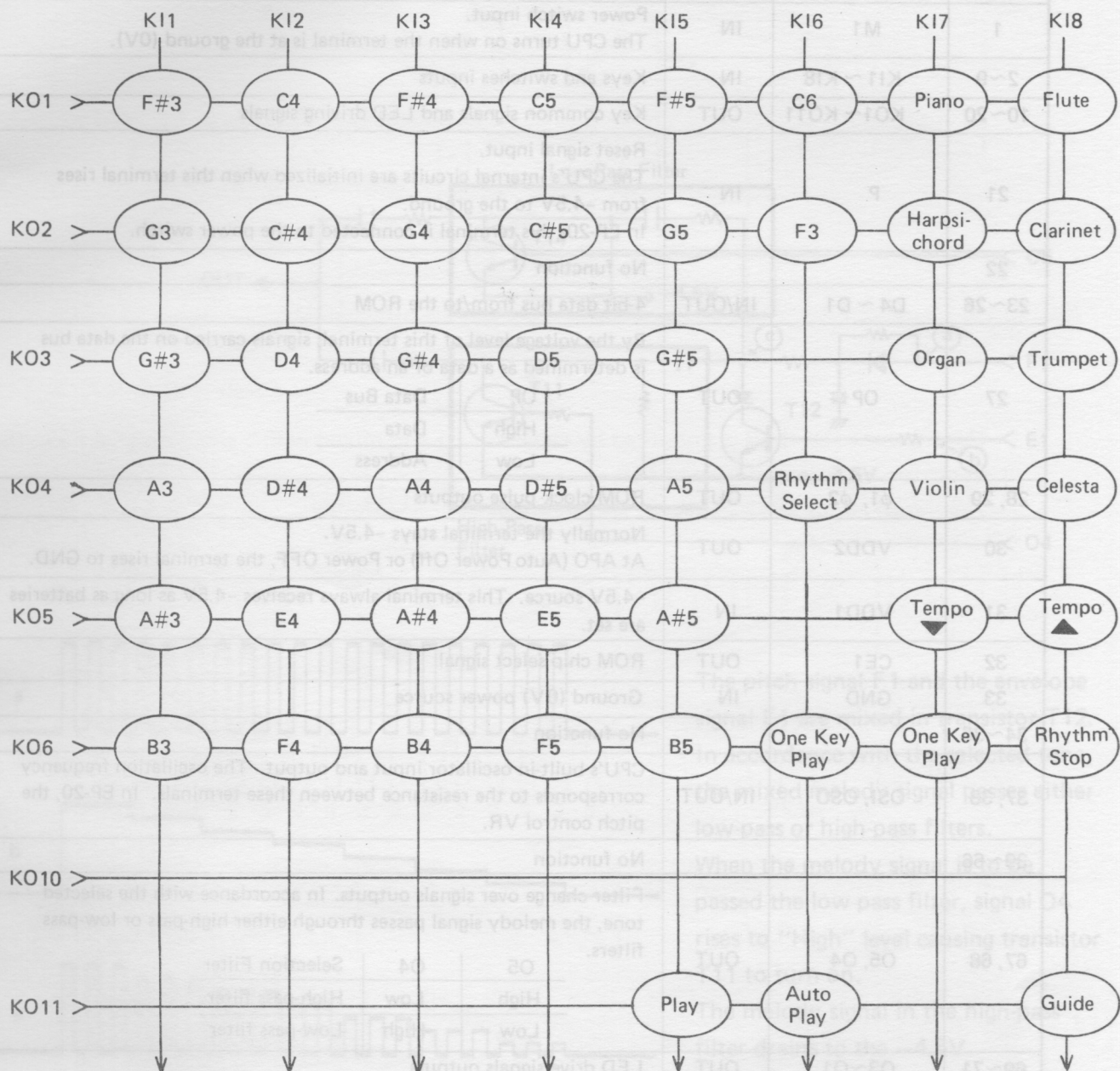
A
B
C
D
E
F
G
H



2. BLOCK DIAGRAM



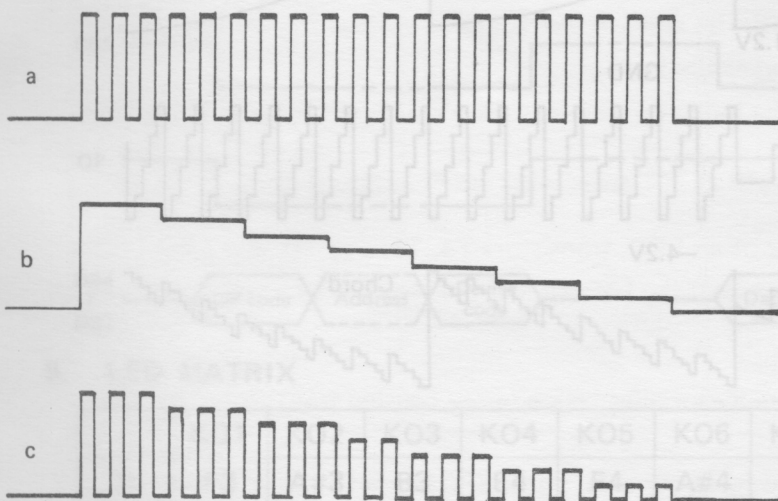
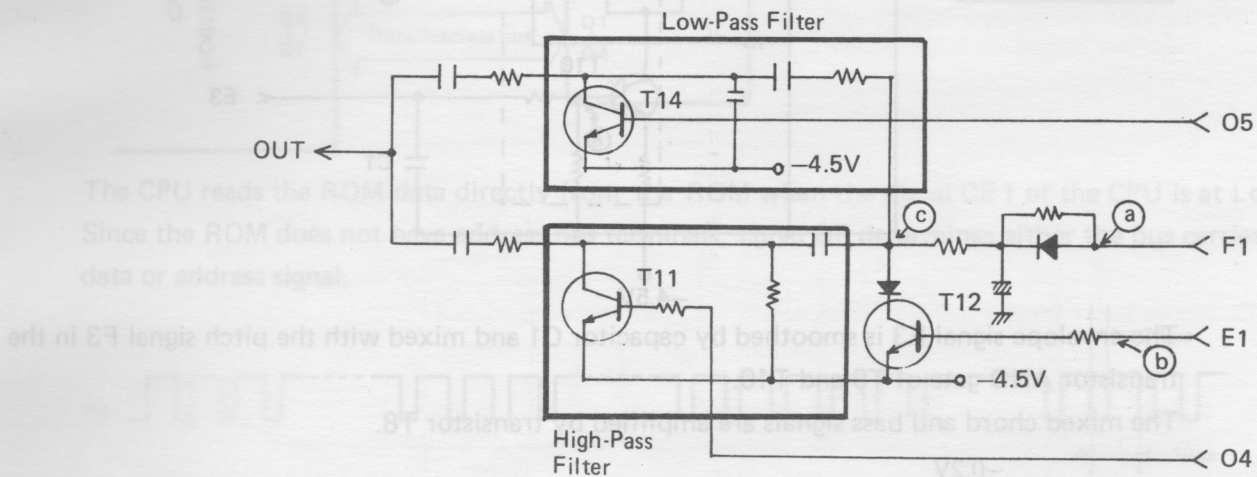
3. KEY & SWITCH MATRIX



4. CPU PIN FUNCTIONS

Pin No.	Terminal Name	IN/OUT	Function									
1	M1	IN	Power switch input. The CPU turns on when the terminal is at the ground (0V).									
2~9	KI1 ~ KI8	IN	Keys and switches inputs									
10~20	KO1~ KO11	OUT	Key common signals and LED driving signals									
21	P	IN	Reset signal input. The CPU's internal circuits are initialized when this terminal rises from -4.5V to the ground. In EP-20, this terminal is connected to the power switch.									
22			No function									
23~26	D4 ~ D1	IN/OUT	4-bit data bus from/to the ROM									
27	OP	OUT	By the voltage level of this terminal, signals carried on the data bus is determined as a data or an address. <table><tr><td>OP</td><td>Data Bus</td></tr><tr><td>High</td><td>Data</td></tr><tr><td>Low</td><td>Address</td></tr></table>	OP	Data Bus	High	Data	Low	Address			
OP	Data Bus											
High	Data											
Low	Address											
28, 29	φ1, φ2	OUT	ROM clock pulse outputs									
30	VDD2	OUT	Normally the terminal stays -4.5V. At APO (Auto Power Off) or Power OFF, the terminal rises to GND.									
31	VDD1	IN	-4.5V source. This terminal always receives -4.5V as long as batteries are set.									
32	CE1	OUT	ROM chip select signal									
33	GND	IN	Ground (0V) power source									
34~36			No function									
37, 38	OSI, OSO	IN/OUT	CPU's built-in oscillator input and output. The oscillation frequency corresponds to the resistance between these terminals. In EP-20, the pitch control VR.									
39~66			No function									
67, 68	O5, O4	OUT	Filter change over signals outputs. In accordance with the selected tone, the melody signal passes through either high-pass or low-pass filters. <table><tr><td>O5</td><td>O4</td><td>Selection Filter</td></tr><tr><td>High</td><td>Low</td><td>High-pass filter</td></tr><tr><td>Low</td><td>High</td><td>Low-pass filter</td></tr></table>	O5	O4	Selection Filter	High	Low	High-pass filter	Low	High	Low-pass filter
O5	O4	Selection Filter										
High	Low	High-pass filter										
Low	High	Low-pass filter										
69~71	O3~O1	OUT	LED drive signals outputs									
72			No function									
73	SPC	OUT	APO (Auto Power Off) control signal output. When the EP-20 is left unoperated for approximately 8 minutes, the terminal drops to -4.5 volts shutting the voltages off.									
74	RH	OUT	Percussion signal output									
75	E3	OUT	Chord and bass envelope signal output									
76	F3	OUT	Chord and bass pitch signal output									
77	E2	OUT	Obbligato (a background sound for accompanying the melody) envelope signal output									
78	F2	OUT	Obbligato pitch signal output									
79	E1	OUT	Melody envelope signal output									
80	F1	OUT	Melody pitch signal output									

5. MELODY CIRCUIT



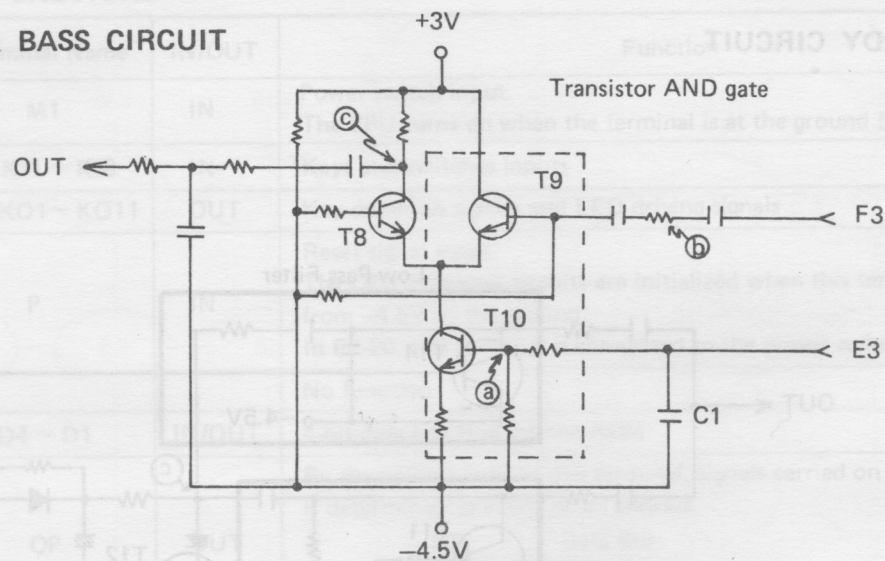
The pitch signal F1 and the envelope signal E1 are mixed in transistor T12. In accordance with the selected tone, the mixed melody signal passes either low-pass or high-pass filters.

When the melody signal is to be passed the low-pass filter, signal O4 rises to "High" level causing transistor T11 to turn on.

The melody signal in the high-pass filter drains to the -4.5V.

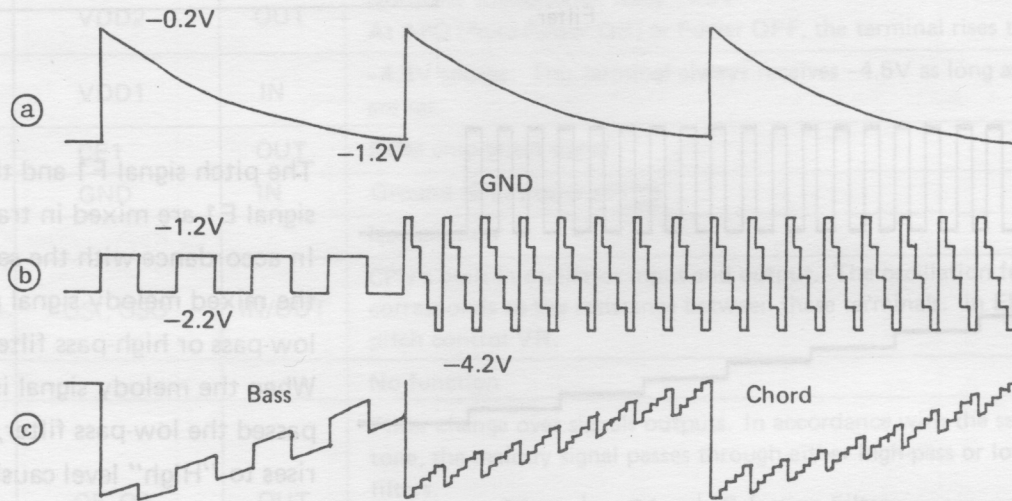
If the melody sound should be high-pass-filtered, signal O5 turns transistor T14 on resulting low-pass-filtered signal to cut off.

6. CHORD & BASS CIRCUIT



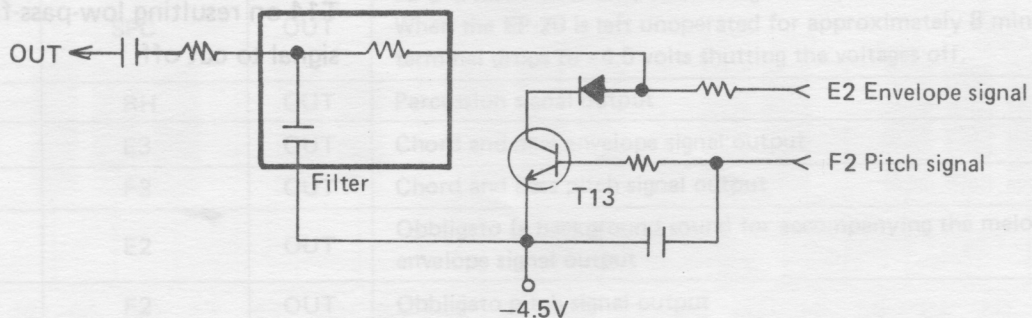
The envelope signal E3 is smoothed by capacitor C1 and mixed with the pitch signal F3 in the transistor AND gate of T9 and T10.

The mixed chord and bass signals are amplified by transistor T8.



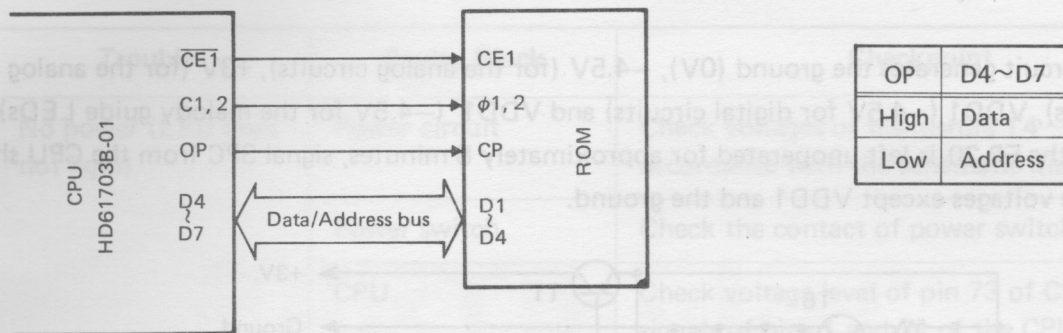
7. OBLIGATO CIRCUIT

Obligato is the back ground sound which accompanies the melody and sounds only at the Auto play mode.

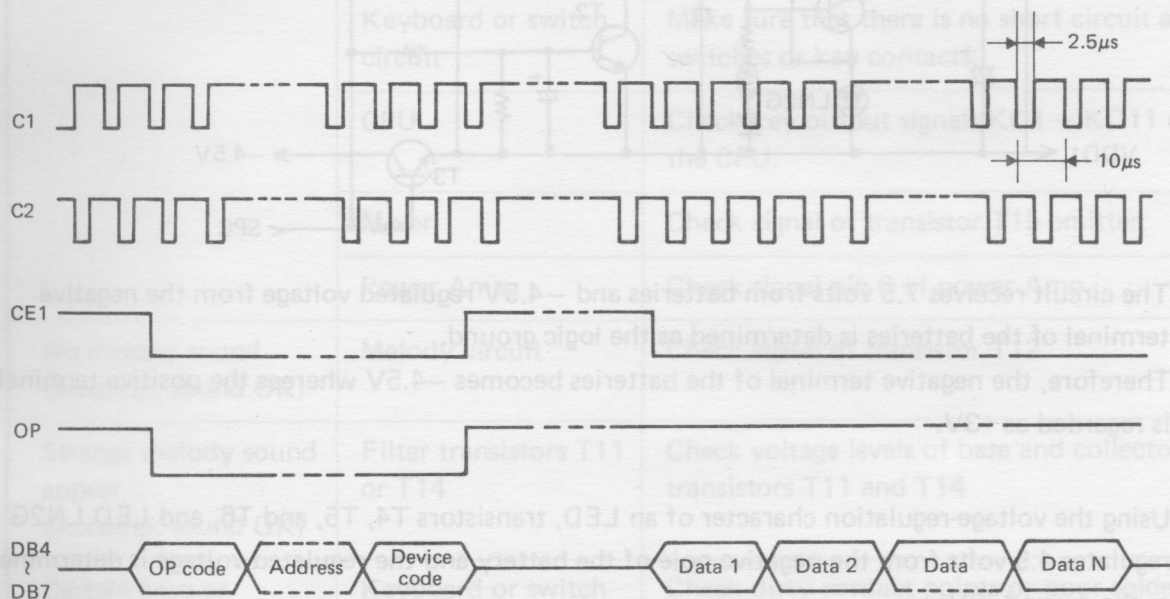


The envelope signal E2 and the pitch signal F2 are mixed in transistor T13 and the mixed obligato waveform is smoothed by the low-pass filter.

8. ROM PACK ACCESS

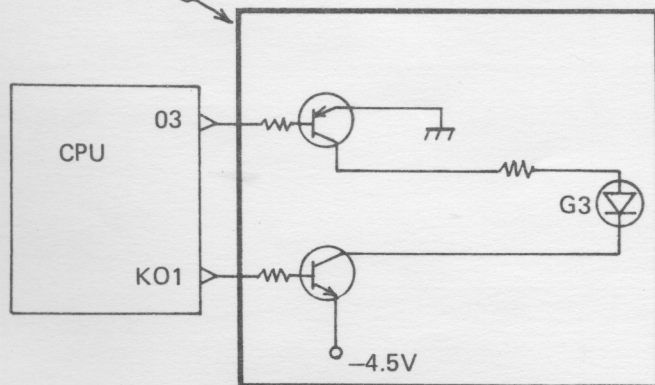


The CPU reads the ROM data directly from the ROM when the signal CE 1 of the CPU is at Low. Since the ROM does not have address bus terminals, signal OP determines either the bus carries data or address signal.



9. LED MATRIX

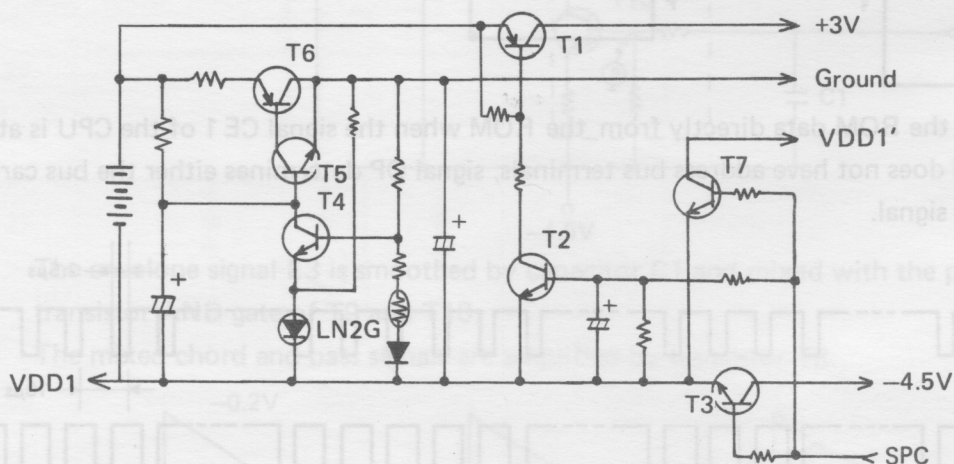
	KO1	KO2	KO3	KO4	KO5	KO6	KO7	KO8	KO9	KO10	KO11
01	F3	A#3	B3	E4	F4	A#4	B4	E#5	F5	A#5	B5
02	F#3	A3	C4	D#4	F#4	A4	C5	D#5	F#5	A5	C6
03	G3	G#3	C#4	D4	G4	G#4	C#5	D5	G5	G#5	



The LED for G3 is lit when O3 is "Low" and KO1 is "High".

10. POWER SUPPLY CIRCUIT

This circuit generates the ground (0V), -4.5V (for the analog circuits), $+3\text{V}$ (for the analog circuits), V_{DD1} (-4.5V for digital circuits) and V_{DD1}' (-4.5V for the melody guide LEDs). When the EP-20 is left unoperated for approximately 8 minutes, signal SPC from the CPU shuts off the voltages except V_{DD1} and the ground.



The circuit receives 7.5 volts from batteries and -4.5V regulated voltage from the negative terminal of the batteries is determined as the logic ground.

Therefore, the negative terminal of the batteries becomes -4.5V whereas the positive terminal is regarded as $+3\text{V}$.

Using the voltage-regulation character of an LED, transistors T4, T5, and T6, and LED LN2G regulates 4.5 volts from the negative pole of the battery and the regulated voltage is determined as the ground (0V).

Signal SPC is from the CPU and normally supplies "High" level causing transistors T2, T3 and T7 to turn on.

When the keyboard is left unoperated for 8 minutes, signal SPC drops to "Low", transistors T2, T3, and T7 are turned off resulting the voltages $+3\text{V}$, -4.5V , and V_{DD1}' to shut off.

11. TROUBLESHOOTING

Trouble	Faulty Block	Checkpoint
No power (LED does not light)	Power circuit	Check voltages of transistors T4 ~ T7 in accordance with the schematic diagram.
	Power switch	Check the contact of power switch.
	CPU	Check voltage level of pin 73 of CPU or signals of pins 1 and 21 of the CPU.
No sound at all (LED lights)	Power circuit	Check voltages of transistors T1 ~ T3 in accordance with the schematic diagram.
	Keyboard or switch circuit	Make sure that there is no short circuit at the switches or key contacts.
	CPU	Check key output signals KO1 ~ KO11 of the CPU.
	Mixer	Check signal of transistor T15 emitter.
	Power Amp.	Check signal pin 6 of power Amp.
No melody sound (Accomp. sound OK)	Melody circuit	Check signal of transistor T12.
Strange melody sound appear (Accomp. sound OK)	Filter transistors T11 or T14	Check voltage levels of base and collector of transistors T11 and T14
Certain keys or switches do not respond	Keyboard or switch circuit	Check dirty contact points or poor solder of diodes of PCB MA1M.

- Notes:
1. Prices and specifications are subject to change without prior notice.
 2. As for spare parts order and supply, refer to the "GUIDEBOOK for Spare Parts Supply", published separately.
 3. The numbers in item column correspond to the same numbers in drawing.

PARTS LIST

EP-20

- Notes:
1. Prices and specifications are subject to change without prior notice.
 2. As for spare parts order and supply, refer to the "GUIDEBOOK for Spare Parts Supply", published separately.
 3. The numbers in item column correspond to the same numbers in drawing.

Item	Code No.	Part Name	Specification	Q'ty	Unit Price N.R. Yen (¥) (FOB: JAPAN)	Rank
1)	M3182-MA1M	PCB ASS'Y				
2	2001 7340	IC (CPU)	HD-61703801	1		B
3	2010 3264	LSI (ROM)	MSM-5268-67GS-K	1		B
4	2120 4940	Speaker IC (Power amp.)	LA4145	1		B
5	2210 0230	Transistor	2SA1163-E, F	1	10	B
6	2253 9018	Transistor	2SC3198-E, F	1	10	B
7	2766 0091	Variable Resistor	VR-10K-1000	1	10	C
8	2765 0095	Fixed Resistor	VR-10K-1500K	1	20	C
9	2801 0080	Jack	YKB21-5152	1		C
10	2720 0000	PC speaker M189B	JFI-50-14-80	1	10	C
11	2252 0290	Transistor	2SA1266Y-AT-T	4	10	B
12	2252 0294	Transistor	2SC3198Y-AT-T	12	10	B
13	2257 0295	Signal transistor	2SC4218-AC-T	11	10	B
14	2301 0240	Diode	1SS54T-77-T	14	20	X
15	2370 0110	LED	LTZ-MR15T-77-T	1	20	C
16	2370 0118	LED	LTZ-MR15T-77-T	1	20	C
17	2603 0270	Carbon film resistor	ELR50X100-J-T34V-T (1/2W, 100ohm, ±5%)	2	20	X
18	2617 0000	Carbon film resistor	R-20-100-J-T24-T (1/5W, 100ohm, ±5%)	3	20	X
19	2617 0020	Carbon film resistor	R-20-220-J-T24-T (1/5W, 220ohm, ±5%)	1	20	X
20	2617 0040	Carbon film resistor	R-20-560-J-T24-T (1/5W, 560ohm, ±5%)	1	20	X
21	2617 0050	Carbon film resistor	R-20-1K-J-T24-T (1/5W, 1Kohm, ±5%)	3	20	X
22	2617 0060	Carbon film resistor	R-20-2.2K-J-T24-T (1/5W, 2.2Kohm, ±5%)	5	20	X
23	2617 0080	Carbon film resistor	R-20-3.3K-J-T24-T (1/5W, 3.3Kohm, ±5%)	1	20	X
24	2617 0100	Carbon film resistor	R-20-10K-J-T24-T (1/5W, 10Kohm, ±5%)	8	20	X
25	2617 0120	Carbon film resistor	R-20-33K-J-T24-T (1/5W, 33Kohm, ±5%)	4	20	X
26	2617 0140	Carbon film resistor	R-20-47K-J-T24-T (1/5W, 47Kohm, ±5%)	3	20	X
27	2617 0160	Carbon film resistor	R-20-100K-J-T24-T (1/5W, 100Kohm, ±5%)	1	20	X
28	2617 0180	Carbon film resistor	R-20-150K-J-T24-T (1/5W, 150Kohm, ±5%)	1	20	X

Notes: New parts

Q'ty - Quantity used per unit

• - Minimum order and supply quantity - 13 -

Rank: A: Essential

B: Stock recommended

C: Others

X: No stock recommended

Item	Code No.	Part Name	Specification	Q'ty	*	Unit Price N.R. Yen (¥) (FOB: JAPAN)	Rank
	1) M3189-MA1M PCB ASS'Y						
	2001 7741	LSI (CPU)	HD-61703B01	1			B
☆	2010 2954	LSI (ROM)	MSM-5268-57GS-K	1			B
	2120 8540	Monolithic IC (Power amp.)	LA4145	1			B
	2210 6228	Transistor	2SB598-E, F	1	10		B
	2253 0014	Transistor	2SD545E, F	1	10		B
☆	2755 0091	Trimmer condenser	ERT-D2FHL103S	1	10		C
☆	2765 0406	Semi-Fixed resistor	V8K4-1SB30K	1	20		C
18	3501 0840	Jack	YKB21-5152	1			C
☆	3725 0903	PC joiner M189B	JFF50-14-80	1	10		C
☆	2250 0091	Transistor	2SA1266Y-AT-T	4	10		B
☆	2252 0084	Transistor	2SC3198Y-AT-T	12	10		B
☆	2252 0245	Digital transistor	2SC4216-AC-T	11	10		B
	2301 0241	Diode	1SS254T-77-T	14	20		X
☆ 19	2370 0112	LED	LN28RPX-(TT8)	1	20		C
☆	2370 0119	LED	LTZ-MR15T-77-T	1	20		C
☆	2603 4272	Carbon film resistor	ELR50X100-J-T34V-T (1/2W, 100ohm, ±5%)	2	20		X
	2617 0028	Carbon film resistor	R-20-100-J-T24-T (1/5W, 100ohm, ±5%)	3	20		X
	2617 0036	Carbon film resistor	R-20-220-J-T24-T (1/5W, 220ohm, ±5%)	1	20		X
	2617 0044	Carbon film resistor	R-20-560-J-T24-T (1/5W, 560ohm, ±5%)	1	20		X
	2617 0052	Carbon film resistor	R-20-1K-J-T24-T (1/5W, 1Kohm, ±5%)	3	20		X
	2617 0061	Carbon film resistor	R-20-2.2K-J-T24-T (1/5W, 2.2Kohm, ±5%)	5	20		X
	2617 0079	Carbon film resistor	R-20-3.3K-J-T24-T (1/5W, 3.3Kohm, ±5%)	1	20		X
	2617 0087	Carbon film resistor	R-20-4.7K-J-T24-T (1/5W, 4.7Kohm, ±5%)	5	20		X
	2617 0095	Carbon film resistor	R-20-10K-J-T24-T (1/5W, 10Kohm, ±5%)	8	20		X
	2617 0109	Carbon film resistor	R-20-33K-J-T24-T (1/5W, 33Kohm, ±5%)	4	20		X
	2617 0117	Carbon film resistor	R-20-47K-J-T24-T (1/5W, 47Kohm, ±5%)	3	20		X
	2617 0141	Carbon film resistor	R-20-100K-T24-T (1/5W, 100Kohm, ±5%)	1	20		X
	2617 0150	Carbon film resistor	R-20-150K-T24-T (1/5W, 150Kohm, ±5%)	1	20		X

Note: ☆ — New parts

Q'ty — Quantity used per unit

* — Minimum order and supply quantity — 13 —

Rank A: Essential

B: Stock recommended

C: Others

X: No stock recommended

Item	Code No.	Part Name	Specification	Q'ty	*	Unit Price N.R. Yen (¥) (FOB: JAPAN)	Rank
	2617 0168	Carbon film resistor	R-20-220K-J-T24-T (1/5W, 220Kohm, ±5%)	2	20		X
	2617 0176	Carbon film resistor	R-20-1M-J-T24-T (1/5W, 1Mohm, ±5%)	1	20		X
☆	2617 0211	Carbon film resistor	R-20-120-J-T24-T (1/5W, 120ohm, ±5%)	1	20		X
	2617 0238	Carbon film resistor	R-20-680-J-T24-T (1/5W, 680ohm, ±5%)	1	20		X
	2617 0246	Carbon film resistor	R-20-12K-J-T24-T (1/5W, 12Kohm, ±5%)	1	20		X
	2617 0254	Carbon film resistor	R-20-62K-J-T24-T (1/5W, 62Kohm, ±5%)	1	20		X
	2617 0262	Carbon film resistor	R-20-120K-J-T24-T (1/5W, 120Kohm, ±5%)	3	20		X
	2617 0265	Carbon film resistor	R-20-10-J-T-24-T (1/5W, 10ohm, ±5%)	1	20		X
	2617 0271	Carbon film resistor	R-20-5.6K-J-T24-T (1/5W, 5.6Kohm, ±5%)	5	20		X
	2617 0297	Carbon film resistor	R-20-22K-J-T24-T (1/5W, 22Kohm, ±5%)	2	20		X
	2617 0301	Carbon film resistor	R-20-56K-J-T24-T (1/5W, 56Kohm, ±5%)	1	20		X
☆	2617 0351	Carbon film resistor	R-20-91K-J-T24-T (1/5W, 91Kohm, ±5%)	1	20		X
	2617 0360	Carbon film resistor	R-20-1.5K-J-T24-T (1/5W, 1.5Kohm, ±5%)	1	20		X
	2617 0378	Carbon film resistor	R-20-3.9K-J-T24-T (1/5W, 3.9Kohm, ±5%)	1	20		X
	2617 0386	Carbon film resistor	R-20-330-J-T24-T (1/5W, 330ohm, ±5%)	1	20		X
	2617 0394	Carbon film resistor	R-20-680K-J-T24-T (1/5W, 680Kohm, ±5%)	1	20		X
☆	2801 7413	Electrolytic capacitor	10RE2-330-T2-T (10V, 330μF, ±20%)	2	20		X
	2804 5956	Electrolytic capacitor	50RE2-2R2-T2-T (50V, 2.2μF, ±20%)	1	10		X
	2805 3134	Electrolytic capacitor	10RE2-22-T2-T (10V, 22μF, ±20%)	2	20		X
	2807 1023	Electrolytic capacitor	50RE2-1-T2-T (50V, 1μF, ±20%)	5	10		X
	2807 1112	Electrolytic capacitor	10RE2-100-T2-T (10V, 100μF, ±20%)	1	20		X
	2807 1121	Electrolytic capacitor	10RE2-220-T2-T (10V, 220μF, ±20%)	1	20		X

Note: ☆ — New parts
Q'ty — Quantity used per unit
* — Minimum order and supply quantity

Rank A: Essential
B: Stock recommended
C: Others
X: No stock recommended

Item	
☆ 1	3
☆ 2	6
☆ 3	6
☆ 4	6
☆ 5	6
☆ 6	6
☆ 7	6
8	6
9	6
☆10	6
☆11	6
4	
☆12	6
☆13	6

Note:

	Rank	Item	Code No.	Part Name	Specification	Q'ty	*	Unit Price N.R. Yen (¥) (FOB: JAPAN)	Rank
	X		2807 1180	Electrolytic capacitor	10RE2-47-T2-T (10V, 47 μ F, \pm 20%)	1	20		X
	X		2818 0365	Ceramic capacitor	RT-HE50TKYB102K-T (50V, 1000pF, \pm 10%)	1	10		X
	X		2818 0420	Ceramic capacitor	RT-HE40TKYB471K-T (50V, 470pF, \pm 10%)	1	10		X
	X		2818 0535	Ceramic capacitor	RT-HE10TKYB822K-T (50V, 8200pF, \pm 10%)	1	10		X
	X		2818 1094	Ceramic capacitor	RT-HE95TKYB682K-T (50V, 6800pF, \pm 10%)	1	10		X
	X		2818 2082	Ceramic capacitor	RT-HE70TKYF103Z-T (50V, 1000pF, \pm 80%, -20%)	3	10		X
	X		2818 3321	Ceramic capacitor	RT-HE60TKCH470J-T (50V, 47pF, \pm 5%)	2	20		X
	X		2819 5052	Semi conductive capacitor	DD408-SR104M16-T (16V, 0.1 μ F, \pm 20%)	9	10		X
	X		2830 6211	Mylar capacitor	AMZV-154K50-T (50V, 0.15 μ F, \pm 10%)	1	10		X
	X		2830 6606	Mylar capacitor	AMZV-224K50-T (50V, 0.22 μ F \pm 10%)	1	10		X
	X	☆	4307 7630	Blank PCB M3189-MA1M	M11305-1	1			X
	X		2) M3119-LD1M PCB ASS'Y						
	X		2320 9845	LED	LN28RPH2-(TA)	19	20		C
	X		2320 9853	LED	LN38GPH2-(TA)	13	20		C
	X		4307 3141	Blank PCB M3119-LD1M	M21037A-1	1			X
	X		3) UPPER CASE ASS'Y						
	X	☆ 1	3831 0042	Speaker	KC06573	1			B
	X	☆ 2	6909 7380	SL contact 9D	CSB-09D	2	20		C
	X	☆ 3	6909 9140	Upper case sub ass'y	M21731*1	1			X
	X	☆ 4	6909 9250	Rubber button 189B	M32714-1	1	10		C
	X	☆ 5	6909 9260	Rubber button 189A	M32713-1	2	5		C
	X	☆ 6	6909 9270	Rubber button 189A	M32713-2	1	5		C
	X	☆ 7	6909 9280	Slide knob 189	M32712-1	2	20		C
	X	8	6910 9853	White key set 2.6	M2483C-3	1			C
	X	9	6910 9961	Contact rubber M110	M31255A-1	1			C
	X	☆10	6913 3220	Black key set 2.6	M2484-4	1	5		C
	X	☆11	6909 9350	Chord seal	M43320-1	1	20		C
	X		4) LOWER CASE ASS'Y						
	X	☆12	6906 0542	Battery cover sub ass'y	M32159B*4	1	5		C
	X	☆13	6909 9131	Lower case sub ass'y	M21732A*1	1			C

Note: ☆ — New parts

Q'ty — Quantity used per unit

* — Minimum order and supply quantity

Rank A: Essential

B: Stock recommended

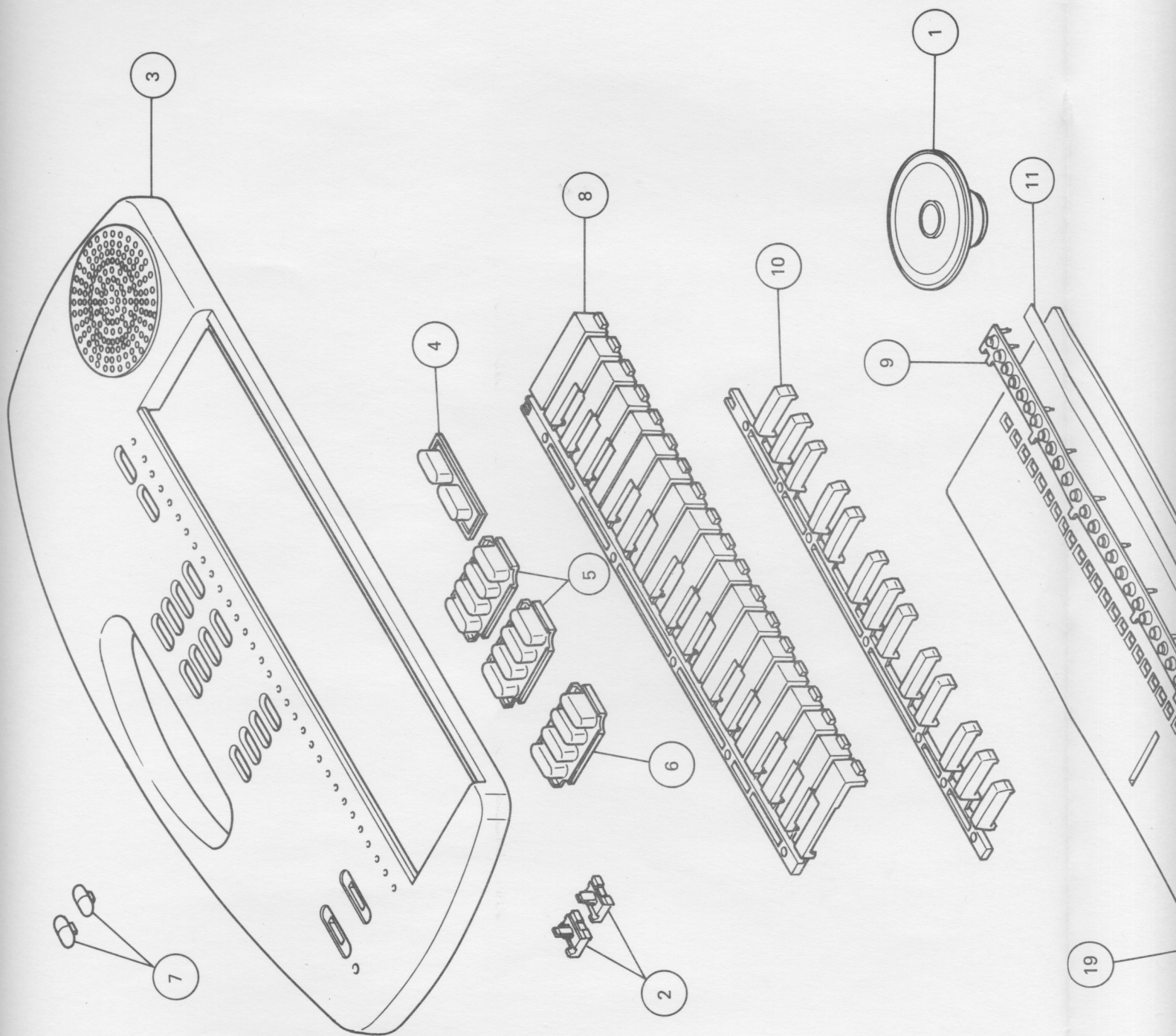
C: Others

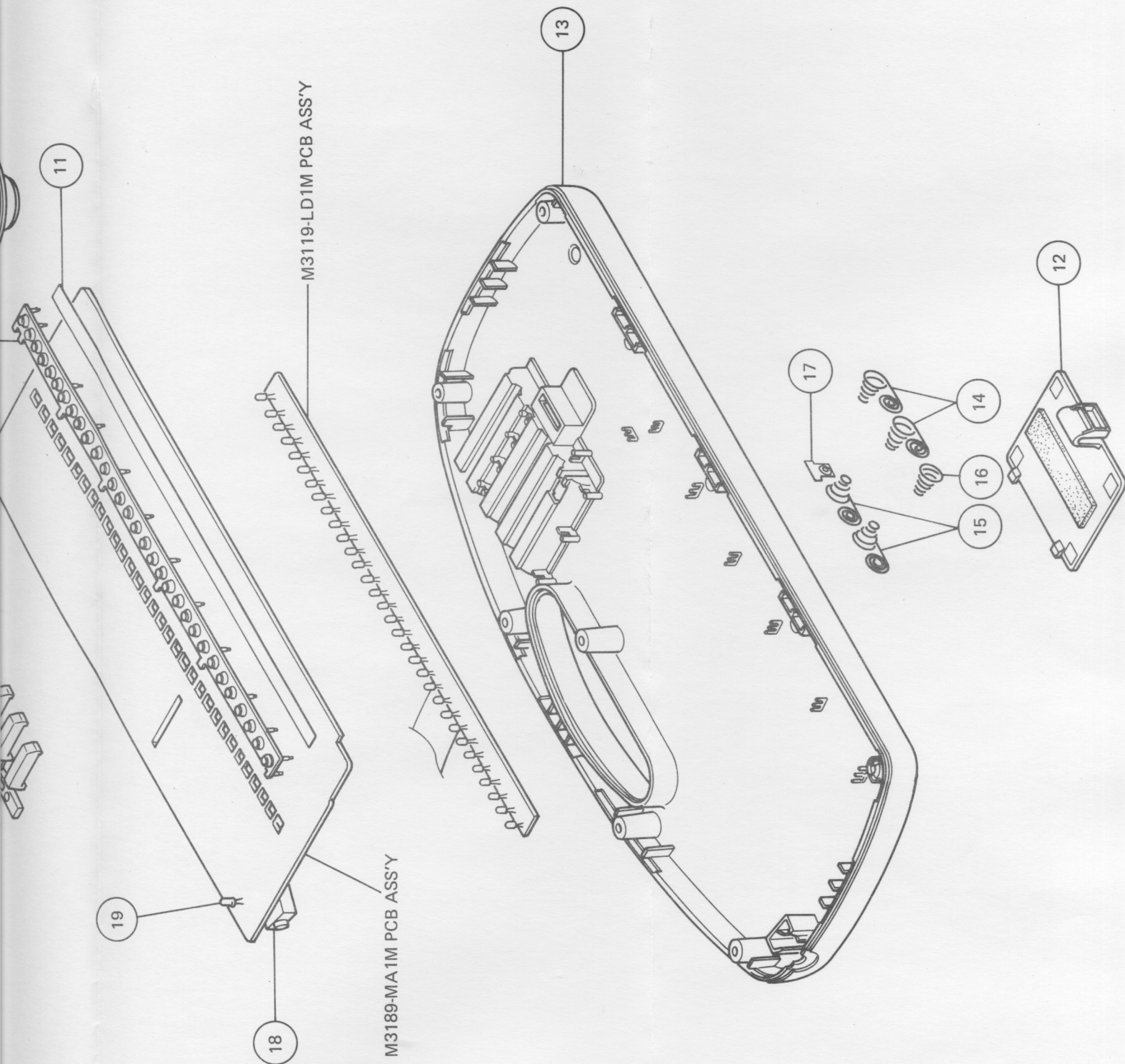
X: No stock recommended

Item	Code No.	Part Name	Specification	Q'ty	*	Unit Price N.R. Yen (¥) (FOB: JAPAN)	Rank
☆14	6911 3540	Battery spring 110R	M41954-1	2	20		C
☆15	6911 3550	Battery spring 110L	M41955-1	2	20		C
☆16	6000 6091	Battery spring G67	A43656-1	1	20		C
☆17	6322 4499	Battery spring A-G55	A42606A-1	1	20		C

Note: ☆ — New parts
Q'ty — Quantity used per unit
* — Minimum order and supply quantity

Rank A: Essential
B: Stock recommended
C: Others
X: No stock recommended





CASIO COMPUTER CO., LTD.

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